1. (Original) A method of determining a distribution of one or more properties in a medium illuminated with radiation from one or more sources, the method comprising the steps of:

   a. receiving the radiation exiting the medium;
   b. deriving one or more optical properties of the medium using one or more calibration factors and the radiation received in step (a), wherein the calibration factors are variables; and
   c. determining the distribution in the medium using the one or more optical properties derived in step (b).

2. (Original) The method of claim 1, wherein at least one of the calibration factors is a source coupling factor.

3. (Original) The method of claim 1, wherein at least one of the calibration factors is a detector coupling factor.

4. (Original) The method of claim 1, wherein at least one of the calibration factors is a source location factor.

5. (Original) The method of claim 1, wherein at least one of the calibration factors is a detector location factor.

6. (Original) The method of claim 1, wherein the medium has characteristics so as to highly scatter the radiation entering therein.

7. (Original) The method of claim 1, wherein the radiation is an electromagnetic radiation.

8. (Original) The method of claim 1, wherein the radiation is an infrared radiation.

9. (Original) The method of claim 1, wherein the radiation comprises near-infrared photons.

10. (Original) The method of claim 1, wherein the radiation is a continuous-wave radiation.

11. (Original) The method of claim 10, wherein at least one of the optical properties includes an absorption coefficient.

12. (Original) The method of claim 10, wherein at least one of the optical properties includes a scattering coefficient.

13. (Original) The method of claim 1, wherein the optical properties are spatially varying optical properties.

14. (Original) The method of claim 1, wherein each of the optical properties is utilized to obtain amplitude and phase of the radiation exiting the medium, which are then used to determine the distribution.

15. (Original) The method of claim 1, wherein each of the optical properties is utilized to obtain intensity and temporal delay of the radiation exiting the medium, which are then used to determine the distribution.

16. (Original) The method of claim 1, further comprising the step of:

d. before step (b), obtaining one or more parameters of the radiation received in step (a).

17. The method of claim 16, wherein at least one of the parameters is fluence.

18. (Original) The method of claim 17, wherein the step (b) comprises the substep of solving an inverse problem based on the one or more parameters and the one or more optical properties.

19. (Original) The method of claim 18, wherein the solving substep comprises the substep of minimizing the equation:

$$F(x)=\sum_{i=1}^{N_{meas}}\left[\ln\Phi_{Theory,i}(x)-\ln\Phi_{Meas,i}\right]^2,$$

wherein index N_{max} is a number of measurements of the received radiation,

$M_{Theory(x)}$ is a theoretical fluence,

$M_{Meas(x)}$ is a measured fluence, and

x is a vector providing a value of a property distribution for each voxel representing a portion of the medium.

20. (Original) The method of claim 19, wherein the minimizing substep comprises utilizing a linear approximation.

21. (Original) The method of claim 20, wherein the linear approximation is a Rytov approximation.

22. (Original) The method of claim 20, wherein the linear approximation is a Born approximation.

23. (Original) The method of claim 16, wherein the obtained parameters are functions of the calibration factors.

24. (Original) The method of claim 23, wherein at least one of the calibration factors is a source coupling factor.

25. (Original) The method of claim 23, wherein at least one of the calibration factors is a detector coupling factor.

26. (Original) The method of claim 23, wherein at least one of the calibration factors is a source location factor.

27. (Original) The method of claim 23, wherein at least one of the calibration factors is a detector

location factor.

28. (Original) The method of claim 1, wherein at least one of the one or more optical properties includes an absorption coefficient value.

29. (Original) The method of claim 1, wherein at least one of the one or more optical properties includes a scattering coefficient value.

30. (Original) The method of claim 1, wherein the one or more optical properties include an absorption coefficient and a scattering coefficient.

31. (Original) The method of claim 1, further comprising the step of:

e. reconstructing at least one image of the medium by using the distribution determined in step (c).

32. (Original) The method of claim 31, further comprising the step of:

f. displaying the reconstructed images for review by human operators.

33. (Original) A method of measuring a distribution of at least one property within a medium, the method comprising:

a. illuminating the medium with radiation from a plurality of sources;
b. receiving radiation from the medium with a plurality of detectors;
c. measuring at least one parameter of the received radiation; and
d. calculating the distribution of the at least one property based on the at least one measured parameter by including source and detector calibration factors as freely varying quantities that are reconstructed in a model for a radiative transport within the medium.

34. (Original) The method of claim 33, wherein a probability that photons entering the medium will scatter greatly exceeds a probability that the photons entering the medium will be absorbed.

35. (Original) The method of claim 33, wherein the radiation is an electromagnetic radiation.

36. (Original) The method of claim 33, wherein the radiation is a continuous-wave radiation.

37. (Original) The method of claim 33, wherein the radiation is an infrared radiation.

38. (Original) The method of claim 33, wherein each source is spatially separated from each detector.

39. (Original) The method of claim 33, wherein the measured parameters are at least one absorption parameter and at least one scattering parameter.

40. (Original) The method of claim 33, wherein the measured parameters are at least one amplitude parameter and at least one phase parameter.

41. (Original) The method of claim 33, wherein the measured parameters are at least one amplitude parameter and at least one temporal off-set parameter.

42. (Original) The method of claim 33, wherein the property distribution is a distribution of at least one of absorption coefficient values and scattering coefficient values.

43. (Original) The method of claim 33, further comprising the step of

e. displaying the property distribution in at least one image.

44. (Original) The method of claim 33, wherein the model includes a non-linear dependence on at least one measured parameter.

45. (Original) The method of claim 33, wherein the model includes a linear dependence on at least one measured parameter.

46. (Original) The method of claim 33, wherein the model includes a Rytov approximation.

47. (Original) The method of claim 46, wherein the model includes the substep of minimizing the following equation:

$$F(x)=\sum_{i=1}^{N_{meas}}\left[\ln \Phi_{Theory,i}(x)-\ln \Phi_{Meas,i}\right]^{2},$$ wherein

N_{max} is a number of measurements of the received radiation,

$M_{Theory(x)}$ is a theoretical fluence,

$M_{Meas(x)}$ is a measured fluence, and

x is a vector providing a value of the property distribution for each voxel of at least one image.

48. (Original) The method of claim 33, wherein the model includes an arrangement for scaling all measured parameters taken as input to make the measured parameters dimensionless and to be of the same order as the source and detector calibration factors.

49. A computer readable medium, comprising:

a program, which when executed, is capable of causing a processor to:

(i) receive radiation exiting the medium,

(ii) derive one or more optical properties of the medium by using the received radiation and one or calibration factors, wherein the calibration factors are variables, and

(iii) determine as output the distribution of one or more optical properties based on the received radiation and one or more calibration factors.

50. (Original) The computer readable medium of claim 49, wherein the program, when executed, is capable of causing the processor to reconstruct at least one image of the output.

51. (Original) The computer readable medium of claim 49, wherein at least one of the calibration factors is a source coupling factor.

52. (Original) The computer readable medium of claim 49, wherein at least one of the calibration factors is a detector coupling factor.

53. (Original) The computer readable medium of claim 49, wherein at least one of the calibration factors is a source location factor.

54. (Original) The computer readable medium of claim 49, wherein at least one of the calibration factors is a detector location factor.

55. (Original) The computer readable medium of claim 49, wherein the medium has characteristics so as to highly scatter light entering therein.

56. (Original) The computer readable medium of claim 49, wherein the optical properties are spatially varying optical properties.

57. (Original) The computer readable medium of claim 49, wherein the program causes the processor to obtain one or more parameters of the radiation exiting the medium.

58. (Original) The computer readable medium of claim 57, wherein at least one of the one or more parameters is fluence.

59. (Original) The computer readable medium of claim 58, wherein the program, when executed, is capable of causing the processor to solve an inverse problem based on the one or more parameters and the one or more optical properties.

60. (Original) The computer readable medium of claim 59, wherein the program, when executed, is capable of causing the processor to minimize the equation:

$$F(x) = \sum_{i=1}^{N_{meas}} \left[\ln \Phi_{Theory,i}(x) - \ln \Phi_{Meas,i} \right]^2,$$ wherein

N_{max} is a number of measurements of the received radiation,

$M_{Theory(x)}$ is a theoretical fluence,

$M_{Meas(x)}$ is a measured fluence, and

x is a vector providing a value of the property distribution for each voxel of at least one image.

61. (Original) The computer readable medium of claim 60, wherein the program, when executed, is capable of causing the processor to utilize a linear approximation for minimizing the equation F(x).

62. (Original) The computer readable medium of claim 61, wherein the linear approximation is a Born approximation.

63. (Original) The computer readable medium of claim 61, wherein the linear approximation is a Rytov approximation.

64. (Original) The computer readable medium of claim 63, wherein the obtained parameters of radiation exiting the medium are functions of the calibration factors.

65. (Original) A computer readable medium comprising:

a program, which, when executed, is capable of causing a processor to:

(i) obtain at least one measured parameter of radiation exiting a medium,

(ii) calculate a distribution of at least one property based on the at least one measured parameter by including calibration factors as freely varying quantities that are reconstructed in a model for radiative transport within the medium, and

(iii) provide the property distribution as output.

66. (Original) The system of claim 65, wherein at least one of the calibration factors is a source coupling factor.

67. (Original) The system of claim 65, wherein at least one of the calibration factors is a detector coupling factor.

68. (Original) The system of claim 65, wherein at least one of the calibration factors is a source location factor.

69. (Original) The system of claim 65, wherein at least one of the calibration factors is a detector location factor.

70. (Original) The computer readable medium of claim 65, wherein the model includes a non-linear dependence on at least one measured parameter.

71. (Original) The computer readable medium of claim 65, wherein the model includes a linear dependence on at least one measured parameter.

72. (Original) The computer readable medium of claim 65, wherein the model includes a Rytov approximation.

73. (Original) The computer readable medium of claim 65, wherein the program, when executed, is capable of causing the processor to minimize the equation:

$$F(x) = \sum_{i=1}^{N_{meas}} \left[\ln \Phi_{Theory,i}(x) - \ln \Phi_{Meas,i} \right]^2,$$

wherein:

N_{max} is a number of measurements of the received radiation,

$M_{Theory(x)}$ is a theoretical fluence,

$M_{Meas(x)}$ is a measured fluence, and

x is a vector providing a value of the property distribution for each voxel of at least one image.

74. (Original) The computer readable medium of claim 73, wherein the model includes scaling all measured parameters taken as input to make the measured parameters dimensionless and of the same order as the source and detector calibration factors.

75. (Original) A system for determining a distribution of one or more optical properties of a medium illuminated with radiation from one or more sources, comprising:

a. one or more detectors for receiving radiation; and

b. a processor coupled to the one or more detectors for deriving one or more optical properties from the radiation and one or more calibration factors, wherein the calibration factors are variables, and wherein the processor is programmed to determine the distribution from the derived optical properties.

76. (Original) The system of claim 75, further comprising:

c. a computer database, operationally coupled to the processor, for storing a program that causes the processor to derive the optical properties and determine the distribution.

77. (Original) The system of claim 76, wherein at least one of the calibration factors is a source coupling factor.

78. (Original) The system of claim 76, wherein at least one of the calibration factors is a detector coupling factor.

79. (Original) The system of claim 76, wherein at least one of the calibration factors is a source location factor.

80. (Original) The system of claim 76, wherein at least one of the calibration factors is a detector location factor.

81. (Original) The system of claim 76, wherein the medium has characteristics so as to highly scatter radiation entering therein.

82. (Original) The system of claim 76, wherein the optical properties are spatially varying optical properties.

83. (Original) The system of claim 76, wherein the radiation is an electromagnetic radiation.

84. (Original) The system of claim 76, wherein the radiation is an infrared radiation.

85. (Original) The system of claim 76, wherein the radiation comprises near-infrared photons.

86. (Original) The system of claim 76, wherein the radiation is a continuous-wave radiation.

87. (Original) The system of claim 86, wherein at least one of the optical properties includes an absorption coefficient.

88. (Original) The system of claim 86, wherein at least one of the optical properties includes a scattering coefficient.

89. (Original) The system of claim 76, wherein each of the optical properties is utilized to obtain amplitude and phase of the radiation exiting the medium, which are then used to determine the distribution.

90. (Original) The system of claim 76, wherein each of the optical properties is utilized to obtain intensity and temporal delay of the radiation exiting the medium, which are then used to determine the distribution.

91. (Original) The system of claim 76, wherein the one or more detectors are adapted to obtain one or more parameters of the radiation.

92. (Original) The system of claim 91, wherein at least one of the parameters is fluence.

93. (Original) The system of claim 92, wherein the processor is programmed to solve an inverse problem based on the one or more parameters and the one or more optical properties.

94. The system of claim 93, wherein the processor is programmed to minimize the equation:

$$F(x) = \sum_{i=1}^{N_{meas}} \left[\ln \Phi_{Theory,i}(x) - \ln \Phi_{Meas,i}\right]^2,$$

wherein:

N_{max} is a number of measurements of the received radiation,

$M_{Theory(x)}$ is a theoretical fluence,

$M_{Meas(x)}$ is a measured fluence, and

x is a vector providing a value of the property distribution for each voxel of at least one image.

95. (Original) The system of claim 94, wherein the processor is programmed to utilize a linear approximation.

96. (Original) The system of claim 95, wherein the linear approximation is a Born approximation.

97. (Original) The system of claim 95, wherein the linear approximation is a Rytov approximation.

98. (Original) The system of claim 97, wherein the obtained parameters are functions of the calibration factors.

99. (Original) The system of claim 98, wherein at least one of the calibration factors is a source coupling factor.

100. (Original) The system of claim 98, wherein at least one of the calibration factors is a detector coupling factor.

101. (Original) The system of claim 98, wherein at least one of the calibration factors is a source location factor.

102. (Original) The system of claim 98, wherein at least one of the calibration factors is a detector location factor.

103. (Original) The system of claim 76, wherein at least one of the one or more optical properties includes an absorption coefficient.

104. (Original) The system of claim 76, wherein at least one of the one or more optical properties includes a scattering coefficient.

105. (Original) The system of claim 76, wherein the one or more optical properties include both absorption and scattering coefficients.

106. (Original) The system of claim 76, wherein the processor is programmed to reconstruct at least one image of the medium by using the determined distribution.

107. (Original) The system of claim 106, wherein the processor is programmed to display the reconstructed images for review by human operators.

108. (Original) A system for measuring a property distribution within a medium, the system comprising:

a. a plurality of radiation sources;

b. a plurality of detectors that convert the radiation received into signals; and

c. a processor that processes the signals to provide values of the distribution of at least one property of the medium, wherein the values are obtained by applying a model for radiative transport in the medium that reconstructs calibration factors using freely varying quantities.

109. (Original) The system of claim 108, wherein at least one of the calibration factors is a source coupling factor.

110. The system of claim 108, wherein at least one of the calibration factors is a detector coupling factor.

111. (Original) The system of claim 108, wherein at least one of the calibration factors is a source location factor.

112. (Original) The system of claim 108, wherein at least one of the calibration factors is a detector location factor.

113. (Original) The system of claim 108, wherein each source comprises an optical fiber and a laser, and wherein each detector comprises an optical fiber and a photodetector.

114. (Original) The system of claim 108, wherein the radiation is an electromagnetic radiation.

115. (Original) The system of claim 108, wherein the radiation is a continuous-wave radiation.

116. (Original) The system of claim 108, wherein the radiation is an infrared radiation.

117. (Original) The system of claim 108, wherein each source is spatially separated from each detector.

118. (Original) The system of claim 117, wherein each source extends in a first plane and each detector extends in a second plane which is opposite to the first plane.

119. (Original) The system of claim 118, wherein each source is spatially separated from the other sources by about 2 centimeters and each detector is spatially separated from the other detectors by about 2 centimeters.

120. (Original) The system of claim 108, wherein the processor provides output of at least one of absorption values and scattering values.

121. (Original) The system of claim 108, further comprising a display to provide an image of at least one property of the medium.

122. (Original) The system of claim 121, wherein the display is a computer screen.

123. (Original) The system of claim 108, wherein the model is non-linear.

124. (Original) The system of claim 108, wherein the model is linear.

125. (Original) The system of claim 108, wherein the model includes a Rytov approximation.

126. (Original) The system of claim 125, wherein the model includes minimizing

$$F(x)=\sum_{i=1}^{N_{meas}}\left[\ln\Phi_{Theory,i}(x)-\ln\Phi_{Meas,i}\right]^{2},$$

wherein:

N_{max} is a number of measurements of the received radiation,

$M_{Theory(x)}$ is a theoretical fluence,

$M_{Meas(x)}$ is a measured fluence, and

x is a vector providing a value of the property distribution for each voxel of at least one image.

127. (Original) The system of claim 126, wherein the model includes scaling parameters extracted from the signal as input to make them dimensionless and of the same order as the source and detector calibration factors.

128. (Original) A software system which, when executed on a processing device, determines a distribution of one or more optical properties in a medium illuminated with radiation from one or

more sources, the software system comprising:

a processing subsystem which, when executed on the processing device, configures the processing device to perform the following:

a. obtains parameters of the radiation exiting the medium,

b. derives one or more optical properties of the medium using one or more calibration factors and the obtained parameters, wherein the calibration factors are variables, and

c. determines the distribution in the medium using the one or more derived optical properties.

129. (Original) The software system of claim 128, wherein at least one of the calibration factors is a source coupling factor.

130. (Original) The software system of claim 128, wherein at least one of the calibration factors is a detector coupling factor.

131. (Original) The software system of claim 128, wherein at least one of the calibration factors is a source location factor.

132. (Original) The software system of claim 128, wherein at least one of the calibration factors is a detector location factor.

133. (Original) A system for determining a distribution of one or more optical properties of a medium illuminated with radiation from one or more sources, comprising:

a. means for receiving radiation exiting the medium;

b. means for deriving one or more optical properties of the medium using one or more calibration factors and the received radiation, wherein the calibration factors are variables; and

c. means for determining the distribution in the medium using the derived optical properties.

134. (Original) The system of claim 133, wherein at least one of the calibration factors is a source coupling factor.

135. (Original) The system of claim 133, wherein at least one of the calibration factors is a detector coupling factor.

136. (Original) The system of claim 133, wherein at least one of the calibration factors is a source location factor.

137. (Currently amended) The system of claim 133, wherein at least one of the calibration factors is a detector location factor.

138. (New) The method of claim 1, wherein each of the optical properties is utilized to obtain at least one of the following to determine the distribution:

amplitude and phase of the radiation exiting the medium, and

intensity and temporal delay of the radiation exiting the medium.

139. (New) The computer usable medium of claim 49, wherein each of the optical properties is utilized to obtain at least one of the following to determine the distribution:

amplitude and phase of the radiation exiting the medium, and

intensity and temporal delay of the radiation exiting the medium.

140. (New) The system of claim 75, wherein each of the optical properties is utilized to obtain at least one of the following to determine the distribution:

amplitude and phase of the radiation exiting the medium, and

intensity and temporal delay of the radiation exiting the medium.

141. (New) The software system of claim 128, wherein each of the optical properties is utilized to obtain at least one of the following to determine the distribution:

amplitude and phase of the radiation exiting the medium, and

intensity and temporal delay of the radiation exiting the medium.

142. (New) The system of claim 133, wherein each of the optical properties is utilized to obtain at least one of the following to determine the distribution:

amplitude and phase of the radiation exiting the medium, and

intensity and temporal delay of the radiation exiting the medium.